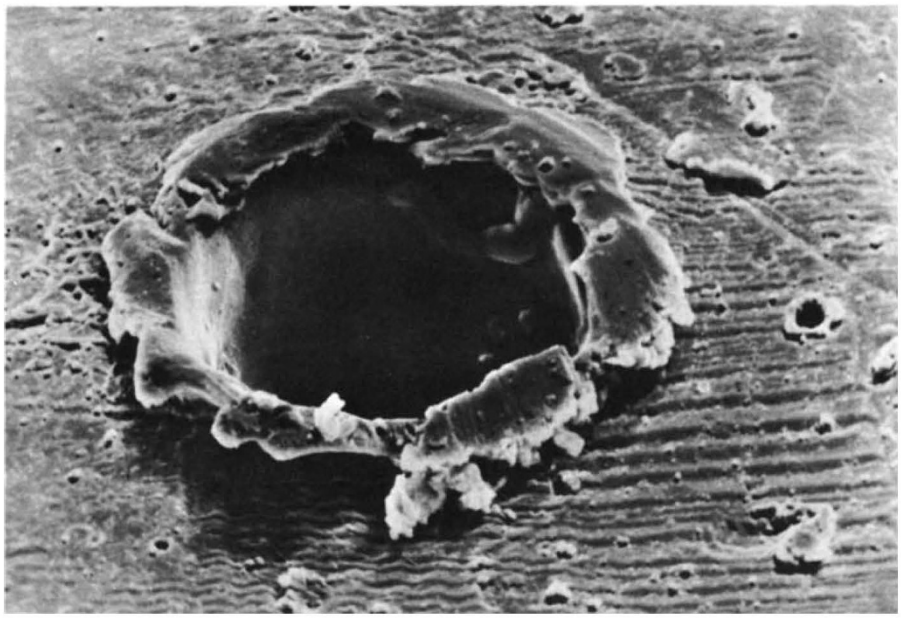
SELENOLOGY

Microcrater in Lunar Meteorite



This lunar crater is only three hundredths of a millimetre across. It was found in a 2 mm by 1 mm fragment of nickel-iron brought back from the Moon by the Apollo 16 astronauts. This specimen is part of a sample sent to the Max-Planck Institute for Nuclear Physics at Heidelberg, and the photograph was taken with a scanning electron microscope at the Siemens laboratory in Karlsruhe. The specimen is itself a fragment of meteorite and has in turn been struck by a micrometeorite which must have been travelling at more than 10 km s^{-1}. As well as the main crater the impact has produced a series of parallel structures in the surface of the sample, together with a smaller crater to the right of the main crater.

it is not known exactly how this happens. The dust storm in progress when Mariner 9 reached Mars became the longest and most severe ever seen. When the dust eventually settled into a layer possibly only a few millimetres thick the effects of aeolian action were seen everywhere. Slides were shown of features formed by wind in terrestrial deserts.

Craters interrupt the smooth flow of wind, causing the formation of dunes inside craters and long streaks downwind of them, and an analysis of streak directions has allowed the atmospheric circulations to be plotted, although only the abnormal conditions of a planet-wide dust storm may be represented. The importance of aeolian effects on Mars has stimulated modelling of erosion features in wind tunnels in the hope that spacecraft photographs may be more fully interpreted. Films of the erosion of craters in a wind tunnel were shown and obvious similarities with martian craters were seen.

Wind cannot account for all the erosion, however. In particular, channels are seen, some of them hundreds of kilometres long, which are morphologically similar to intermittent streams in terrestrial deserts. The meeting participants accepted that this implied the existence of huge quantities of flowing water at some time although water on Mars would quickly evaporate. A clue to the origin of these channels is the observation of areas of "cracked ground", characteristic of permafrost regions, near the heads of some of them. It seems possible that rapid melting of permafrost could have given rise to transient rivers but the origin of the permafrost is unknown.

Extreme dryness is the most serious impediment to the development of life on Mars. Consequently the two landing craft of the 1976 Viking mission, whose main object is the search for life, will be put down where water is most likely to have been present. One will land at a confluence of dry river channels and the other in the region with most water vapour at the time.

The polar regions of Mars also received attention. At each pole there is a region of "laminated ground" which is interpreted as a 6 km thick covering of layered deposits which are at present being eroded. The material removed is being redeposited in the zones north and south of 30° latitude which are covered by a smooth mantle and appear to be areas of deposition. In spite of the thick layer of deposits the poles are lower than their surroundings and this means that isostatic adjustment—the sinking of the crust under the extra load—has occurred.

This and the volcanic evidence indicate that the interior is warm and the crust relatively thin so that the idea of incipient crustal movement is plausible. Evidence against this is that Mars is not in hydrostatic equilibrium—this long suspected fact has been confirmed by Mariner 9. This could imply great internal strength but it may be possible to account for it if the interior of Mars, like the Earth's mantle, is undergoing thermal convection.

Link between Coronal and Interplanetary Shocks

CORONAL shock waves generated by solar flares are directly linked to interplanetary shock waves in the solar wind, according to evidence gathered by Pintér and reported in next Monday's *Nature Physical Science* (June 11). This follows the now well established link between type II solar radio bursts and flare-generated coronal shock waves as another step towards a more complete understanding of the Sun's activity as an overall phenomenon rather than a series of unrelated events.

Coronal shock waves are emitted by flares at the time of the triggering instability which can be observed in hydrogen alpha light; at the same time, the type II burst is initiated. Radio data have shown that the resulting shock moves out to at least 7 $R_\odot$, at a velocity of 500 to 4,000 km s^{-1}. At that distance from the Sun, the radio technique used becomes inadequate to monitor further expansion of the wave front. But satellite observations, notably from OSO-7, have now revealed the existence of plasma clouds, moving at velocities of around 1,000 km s^{-1}, at distances beyond 10 $R_\odot$ from the Sun. It now seems that such clouds represent coronal shocks which have escaped from the corona.

Pintér has shown the close relation between flare-generated coronal and interplanetary shock waves by comparing their velocities. Using two detectors (either two artificial space probes or one probe and Earth based instruments) at different distances from the Sun the velocities of the interplanetary shocks can be measured directly. All of those chosen for study were associated with type II bursts, and all were decelerating as they moved outwards. Extrapolating backwards, Pintér deduces the initial velocities of the shock waves, and finds that at 1 $R_\odot$ these are almost identical to the velocities of the coronal shock waves associated with the equivalent type II bursts, measured from the drift of the burst.

For average values of Pintér's data—initial velocity 2,000 km s^{-1}, velocity at 1 a.u. 530 km s^{-1} and particle density 10 cm^{-3}—the energy supplied by the flare to the shock is 6×10^{30} erg.